

# **Draft Post-Delisting Monitoring Plan For *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls)**



Photograph of *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls)  
(Photocredit Ayoola Folarin).

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## Acknowledgements

The draft Post-Delisting Monitoring (PDM) Plan for *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls) was compiled and prepared by a number of current and past U.S. Fish and Wildlife Service (Service) staff (Jonathan Snapp-Cook, Brian Root, Todd Archer, Stacey Love, Gjon Hazard, and Bradd Baskerville-Bridges (Carlsbad Fish and Wildlife Office, Carlsbad, California). The California Department of Parks and Recreation (Ken Kietzer), and Rancho Santa Ana Botanic Garden (Naomi Fraga) provided substantial assistance with the preparation of this plan.

## Anti-Deficiency Act Disclaimer

Post-delisting monitoring is a cooperative effort between the Service, State, tribal, foreign governments, other Federal agencies, and nongovernmental partners. Funding of post-delisting monitoring presents a challenge for all partners committed to ensuring the continued viability of Hidden Lake bluecurls following removal of Endangered Species Act protections. To the extent feasible, the Service intends to provide funding for post-delisting monitoring efforts through the annual appropriations process. Nonetheless, nothing in this PDM plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation.



Photograph of *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls) by Michael Wall, RSABG.

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## 1.0 Background

### 1.1 Description and Life History

*Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls) is a small annual herb in the Lamiaceae (mint family). The leaf blade is less than 30 mm long, elliptic, and generally four times longer than wide. The corolla is lavender to purple in color and composed of five fused petals. *Trichostema a.* subsp. *compactum* typically germinates in early July and completes its life cycle as the temperature begins to drop to freezing temperatures (October–November) (Bauder 1999, Fraga and Wall 2007). Plants generally flower from July to September, but this species has been documented flowering as late as November (Fraga and Wall 2007). Fruit and seeds begin to develop in early August (Bauder 1999, Fraga and Wall 2007). *Trichostema a.* subsp. *compactum* has no documented pollinators and has been found to be self-compatible (89.1 percent seed set with the exclusion of pollinators) (Spira 1980). Spira (1980) also found that insects visiting the conspecific taxon *T. a.* subsp. *austromontanum* lacked pollen grains on their dorsal surface (which is needed for the transfer of pollen to stigma), and therefore were not acting as effective pollinators (Spira 1980). This suggests that flowers of this species are not commonly pollinated by insects and are generally self-fertilized.

*Trichostema austromontanum* subsp. *compactum* is mainly restricted to the margins of Hidden Lake in the San Jacinto Mountains, Riverside County, California. The entire known range of *T. a.* subsp. *compactum* encompasses an area of 0.8 hectare (ha) (2 acres (ac)) (Bauder 1999). The standing (plants present versus seeds in soil) population size of *T. a.* subsp. *compactum* varies widely from year to year depending on the amount of winter precipitation and the extent of suitable habitat along the margins of the lake. Census surveys have verified that the standing population size fluctuates greatly. The population has been documented to be over 243,000 individuals in 2012, to as few as 50 individuals in the year 2000 (Fraga and Wall 2008; CNDDB 2010; Fraga 2016, pers. comm.) (Table 1, 2). The population appears smaller during periods of above and below normal precipitation (Bauder 1999). This is due to lack of suitable habitat (a narrow band along the margin of Hidden Lake) and suitable conditions for germination (Bauder 1999).

Plants of this taxon may occur around the entire perimeter of Hidden Lake (Fraga and Wall 2007) with a small subpopulation located northeast and 85 m (280 ft) away from the lake between the lake and Desert View Overlook. However, plants of this species appear to be most abundant on the northern margin of the lake and are relatively scarce along the south side of the lake. The northern margin of the lake receives more sun than the south margin of the lake, and it is likely that the northern margin of the lake is warmer earlier in the spring due to increased exposure to the sun (relative to the southern lake margin). Therefore, the soil on the north side of the lake retains less water as the lake margin recedes, which creates more suitable habitat for this taxon.



## 1.2 Demographics at Time of Proposed Delisting

We noted in the final listing rule for *Trichostema austromontanum* subsp. *compactum* (63 FR 49006; September 14, 1998) that population sizes fluctuated from less than 50 to 10,000 individuals between 1979 and 1991. Though the Service reported in the final rule that the population size "declines during periods of either above or below normal precipitation because of its position along the perimeter of the vernal pool habitat," Bauder (1999) noted that:

The size of the Hidden Lake blue curls population varies greatly from year to year, depending on the availability of suitable habitat, the presence of conditions suitable for germination and the amount of seed stored in the soil. The species appears to germinate and grow only on open soil that is exposed during the summer months when there is a drawdown of Hidden Lake and summer temperatures prevail. The extent of the drawdown, hence the area exposed, depends on the amount of precipitation during the prior wet season.

Despite these annual changes in size, the population is best characterized as stable because the variations are natural and tied primarily to the summer level of the lake. This conclusion is in keeping with Bauder and McMillan (1998) who concluded that "sub-regional climatic variables may be controlling [the] distribution" of the bluecurls and another montane vernal pool species. This apparent stability is enhanced by the observation that the subspecies is self-compatible (capable of producing viable seed by self-fertilization) and individual plants are not dependent on pollinators to produce seed (Spira 1980).

## 1.3 Species Classification and Listing History

*Trichostema austromontanum* subsp. *compactum* was listed as a threatened species in 1998 under the Endangered Species Act (Act), due to trampling and limited numbers, and critical habitat was determined not to be prudent (63 FR 49006; 71 FR 56094; September 26, 2006). Two 5-year Reviews were completed in 2006 and 2013 that stated, "1) management by State Parks has been effective, 2) stochastic (unpredictable) threats are not significant, and 3) sufficient seed has been banked for reintroduction after an adverse stochastic event" (Service 2006, p. 11). In 2007, the Service revisited critical habitat and again found that designating critical habitat was not prudent (72 FR 54377; September 21, 1983).

### *Listing History:*

FR notice: 63 FR 49006

Date listed: September 14, 1998 (effective October 14, 1998)

Entity listed: *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls), a plant subspecies.

Classification: Threatened

The Recovery Priority Number for *Trichostema austromontanum* subsp. *compactum* is 15, according the 2016 Recovery Data Call. This number indicates the subspecies faces a low degree of threat and has a high recovery potential. According to this scale, 1 is the highest-ranked recovery priority and 18 is the lowest (48 FR 43098; September 21, 1983).

## 2.0 Purpose and Objectives

The PDM plan for *Trichostema austromontanum* subsp. *compactum* includes activities to verify that the species remains secure from risk of extinction after the protections of the Endangered Species Act (Act) no longer apply. The primary goal of this PDM plan is to conduct 5 years of monitoring for *T. a.* subsp. *compactum* after the taxon is delisted in order to make sure that re-proposing it as a threatened species or an endangered species is not needed.

Section 4(g) of the Act requires the Service to implement a system in cooperation with the States to monitor for not less than 5 years the status of all species that have recovered and been removed from the list of threatened and endangered plants and animals (list; 50 CFR 17.11, 17.12, 224.101, and 227.4). Section 4(g)(2) of the Act directs the Service to make prompt use of its emergency listing authorities under section 4(b)(7) of the Act to prevent a significant risk to the well-being of any recovered species. While not specifically mentioned in section 4(g) of the Act, authorities to list species in accordance with the process prescribed in sections 4(b)(5) and 4(b)(6) of the Act may also be used to reinstate species on the list, if warranted.

The Service and States have latitude to determine the extent and intensity of PDM that is needed and appropriate. The Act does not require the development of a formal PDM “plan.” However, the Service generally desires to follow a written planning document to provide for the effective implementation of section 4(g) by guiding collection and evaluation of pertinent information over the monitoring period and articulating the associated funding needs. Thus, this document was prepared to describe the PDM for the *Trichostema austromontanum* subsp. *compactum*. This PDM plan follows the Post-Delisting Monitoring Plan Guidance under the Endangered Species Act (Service and NMFS 2008).

*Trichostema austromontanum* subsp. *compactum* is currently managed at Hidden Lake by the State of California. This PDM plan serves to detect changes in abundance data that may indicate negative impacts to the continued stability of the species’ abundance levels. Previously collected weather and abundance data provide valuable baselines to evaluate population demographics (Table 2). Monitoring under this PDM plan will also examine local weather conditions over the period of the plan to identify impacts of weather effects and patterns.

## 3.0 Implementation

*Trichostema austromontanum* subsp. *compactum* is located in Mount San Jacinto State Park. This sole occurrence of *T. a.* subsp. *compactum* lies within both the Mount San Jacinto State Wilderness Area and the Hidden Divide Natural Preserve, which combined, offers the highest level of protection for natural resources that the State Park System can provide (Fraga and Kietzer 2009). The limited distribution of this species has facilitated a focused group of partners toward species recovery. In the years leading up to the proposed delisting, the Service has worked closely with California Department of Parks and Recreation (CDPR) and Rancho Santa Ana Botanic Garden (RSABG). The Service, CDPR, and RSABG bring important capabilities to

the partnership. The main responsibilities and commitments of each partner organization are listed below.

In 2008, a Showing Success grant from the USFWS allowed our partners at CDPR and RSABG to develop a Conservation Strategy which identified opportunities for conservation of *Trichostema austromontanum* subsp. *compactum* (Fraga and Kietzer 2009). The Conservation Strategy has served as a template for recovery actions over the past several years and has provided a springboard to initiate conservation for the species. This information was used to develop the PDM plan for the continued monitoring of *T. a.* subsp. *compactum* after the species is delisted.

### 3.1 Partner Commitments

#### U.S. Fish and Wildlife Service—Agency commitment

1. Science support.
2. Grant funding (assist with locating funding sources).
3. Analysis of *Trichostema austromontanum* subsp. *compactum* monitoring reports.
4. Regulatory support.
5. Administrative assistance during post-delisting monitoring.
6. Providing field staff for 3 days per year for post-delisting monitoring.

#### California Department of Parks and Recreation—Agency commitment

1. Maintain signs and other protections implemented through this project to help conserve *Trichostema austromontanum* subsp. *compactum*.
2. Monitor *Trichostema austromontanum* subsp. *compactum* according to the methods and schedule in the Conservation Strategy and the PDM plan.
3. Coordinate with RSABG and the Service regarding *ex situ* seed banking, future research, and management needs of *Trichostema austromontanum* subsp. *compactum*.
4. Assist in providing access to the Service and RSABG to Mount San Jacinto State Park and Hidden Lake as necessary to achieve the goals of the Conservation Strategy and the PDM plan.
5. Meet reporting requirements of the PDM plan.
6. Request assistance fulfilling the above goals from partners when needed.

#### Rancho Santa Ana Botanic Garden—Institutional commitment

1. Work with the Center for Plant Conservation to include *Trichostema austromontanum* subsp. *compactum* as part of the National Collection of Endangered Plants.
2. Maintain *ex situ* seed bank and provide support for activities where this resource is needed.
3. Explore and pursue additional research questions:
  - a. Taxonomic status of *T. a.* subsp. *compactum* in relation to other *Trichostema* species, particularly *T. a.* subsp. *austromontanum*.
  - b. Population genetics (e.g., determine whether the population is genetically diverse or homogenous).
4. Assist with post-delisting population and habitat monitoring by providing field support at least 1 day per year.

## 4.0 Threats-based Monitoring Focus

Three threats to the subspecies have been identified: trampling by humans or horses; small population size; and climate change. Due to actions taken since listing to minimize trampling, no trampling impacts associated with the recreational use of the area have been reported (Wallace 2003 and 2005, pers. obs.; Snapp-Cook 2006, pers. obs.; Fraga and Wall 2010). In the proposed delisting rule, we discuss actions to minimize stochastic threats to low populations numbers and identify the potential threat of climate change.

### 4.1 Trampling

At the time of listing, trampling was one of the main threats to *Trichostema austromontanum* subsp. *compactum*. Impacts from trampling resulted from people using Hidden Lake for recreation and allowing stock animals to graze in Hidden Lake. These effects were addressed by efforts lowering the visibility of Hidden Lake to the public, removing trail signs for Hidden Lake, and obscuring the trail. Subsequent to listing of *T. a.* subsp. *compactum*, a wooden barrier was installed to exclude horses and pack animals from Hidden Lake. In 2002, when the general plan for the area was updated, Hidden Lake and its watershed received an additional layer of regulatory protection through the designation of the area as Hidden Divide Natural Preserve. This designation grants resource protection precedence over recreational use (CDPR 2002, pp. 62–65).

As part of the Conservation Strategy, a monitoring protocol was developed for measuring the level of visitor use at Hidden Lake. The protocol prescribes regular collections of visitor numbers to Hidden Lake, types of activities they engage in, and recording of trampling evidence (specifically that affecting *Trichostema austromontanum* subsp. *compactum*). This monitoring will be especially important if the area is re-opened to some form of visitor use. This PDM plan provides for monitoring of this type to continue through the post-delisting period.

### 4.2 Small Populations

Limited numbers of plants and the extremely localized range of *Trichostema austromontanum* subsp. *compactum* were considered threats to the species at listing (63 FR 49006).

The small, localized population makes the species susceptible to stochastic events. These impacts may be so severe as to result in significant population loss and an associated loss of genetic variation, or even extinction (Noss *et al.* 1997). Because of a better understanding of the natural soil seed bank, we no longer consider effects associated with small populations and stochastic events to be a significant threat to the subspecies. However, we do recognize that a taxon with such a limited range could be susceptible to disturbance events (e.g., widespread trampling, severe extreme water level alteration, etc.). Compilation of annual *T. a.* subsp. *compactum* demographics and climatic monitoring (see below) detailed in the PDM plan will address facets of this potential threat.



Past monitoring of *Trichostema austromontanum* subsp. *compactum* has provided some record of historical abundance (Table 2). The best indicator of abundance has been the natural variation in the Hidden Lake water level (Bauder 1999). This PDM plan will continue the monitoring of the demographics of the population. Demographic and water level monitoring would then provide a supplemental indicator to population trends.

### 4.3 Climate Change

In the 1998 listing rule, we did not discuss the potential impacts of climate change (63 FR 49006). Impacts associated with climate change could potentially change the physiognomy of Hidden Lake in the coming years. Precipitation may change in timing, form (snow to rain), and amount. If more rain falls during the summer months, it may change the duration and depth of ponding at Hidden Lake. In the specific case of *Trichostema austromontanum* subsp. *compactum*, we are concerned that changes in the amounts and patterns of precipitation could alter the unique high elevation vernal pool environment of Hidden Lake and potentially negatively impact this species. While we recognize that there is some level of uncertainty associated with the predicted downscaled models, there is no information currently available that would lead us to conclude that impacts from climate change is a threat now or likely to be in the future. The degree and extent of impacts associated with climate change will depend on the severity of the changes and the ability of *T. a.* subsp. *compactum* to naturally adapt to the changes that are expected to occur. We have included monitoring in the PDM plan to provide baseline data on climate as well as the duration and depth of ponding that occurs at Hidden Lake. We expect that the maintenance of the *ex situ* seed bank provides us with some flexibility to address stochastic events associated with a changing climate.

Data gathered during monitoring of *Trichostema austromontanum* subsp. *compactum* conditions will provide a baseline for understanding the microclimate of Hidden Lake. As the monitoring continues, data for these parameters will provide the basis for trend analysis and actual change in the microclimate for the species. Trends which may indicate these changes will be apparent in temperature and precipitation. In addition to these measurements, we will benefit from recording data on relative rainfall, soil moisture, and solar radiation. These additional sources of data may provide some insight into germination triggers for *T. a.* subsp. *compactum*.

Data will be recorded for the duration of the PDM plan, to monitor Hidden Lake for changes in weather that may result in an impact to *Trichostema austromontanum* subsp. *compactum*. Collecting temperature, rainfall, and solar radiation data on-site at Hidden Lake will provide the best indicators for trend analysis. These data will be compiled in annual reports to supplement the PDM plan.

## 5.0 Methods

The PDM plan was designed in cooperation with CDPR and RSABG to maximize data continuity and comparability with existing studies to help evaluate potential impacts to *Trichostema austromontanum* subsp. *compactum*. The status of *T. a.* subsp. *compactum* will be monitored every 3 years over a 13-year period (Years 1, 4, 7, 10, and 13). Results generated from

the PDM plan will be used to determine whether the taxon, once removed from the list of Endangered and Threatened Plants, will become threatened with extinction without the protective measures afforded by the Act. Methods for threats-based monitoring are discussed below for trampling, small populations, and climate change.

### **5.1 Trampling**

Actions by CDPR to eliminate trampling as a threat to *Trichostema austromontanum* subsp. *compactum* required excluding hikers and equestrian users from Hidden Lake. Now that trampling has been controlled, CDPR is considering restricted use of the area around Hidden Lake, including Desert View Overlook. Impacts will be monitored to gauge recreational pressures and record instances of actual trampling. Recreational pressures will be monitored using a visitor log at Hidden Lake which records users on foot and users on horseback. Monitoring will be conducted by the CDPR staff on site at Hidden Lake throughout the duration of the PDM plan during the months of August, September, and October (See Appendix C: Monitoring Protocols for *Trichostema austromontanum* subsp. *compactum*). These visits will also serve to ensure CDPR protective measures remain intact. Details of this monitoring are found in Appendix B: Visitor Impacts Monitoring.

### **5.2 Small Populations**

*Trichostema austromontanum* subsp. *compactum* abundance and distribution information from Hidden Lake will be collected when standing plants are present. This monitoring will include one or more surveys, depending on plant growth that year, to indicate relative abundance. It will also provide nominal information on spatial distribution (where plants are found around Hidden Lake) and water level of Hidden Lake. This facet of monitoring will coincide with trampling monitoring at mid-month in August, September, and October of each year of the post-delisting monitoring. Details of this monitoring protocol are found in Appendix C: Monitoring Protocols for *Trichostema austromontanum* subsp. *compactum*.

### **5.3 Climate Change**

A Remote Automated Weather Station (RAWS) in Long Valley is operated by BLM/CDF ([http://mesowest.utah.edu/cgi-bin/droman/station\\_total.cgi?stn=MSJC1and unit=0](http://mesowest.utah.edu/cgi-bin/droman/station_total.cgi?stn=MSJC1and unit=0)) and was installed on July 29, 2008 at 8,616 feet in Little Round Valley, 2.5 miles west of Hidden Lake. This station provides real-time data over the Internet and is primarily used in fire weather predictions (Kietzer 2010). This weather station collects data for temperature, dew point, relative humidity, wind speed/direction, wind gust, and solar radiation.

Hidden Lake may experience a significantly different microclimate, so site-specific weather will be valuable. A similar RAWS at Hidden Lake would not be feasible, due to its large size (25 square feet area, 20 feet high), high costs (\$16,000 to 18,000), and limited collection parameters, (Kietzer 2010). Instead, a HOBO data logger, a small and inexpensive weather station, was installed. It has the potential to collect rainfall, soil moisture, solar radiation, and photosynthetic light in addition to the RAWS parameters. This unit is much cheaper, but is limited to data logging. This limitation will require site visits to retrieve data and replace batteries. Collection of

data using the HOBO station can be integrated with RAWs data to interpolate differences between the climates of Long Valley and Hidden Lake. In addition, a digital camera will be coupled with the HOBO station to record Hidden Lake water levels. A schedule to retrieve captured data and replace batteries will be integrated in the site visit schedule for plant observations.

## 6.0 Analyses and Reporting

Raw data and reports summarizing the activities, data collected, and results of each component of this PDM plan should be submitted to the Service's Carlsbad Fish and Wildlife Office within 6 months following completion of each field season. This will allow the Service, in cooperation with its partners in the PDM plan, to evaluate in a timely manner whether adequate data are being collected. This will also allow the results of periodic assessment of the species through the monitoring program to allow adaptive management. At the end of the period of monitoring specified in this PDM plan, the Service will compile all information and synthesize a final report with regard to potential outcomes (A–D below) as specified in the Post-Delisting Monitoring Guidance (Service and NMFS 2008, pp. 4-3–4-4).

Effective PDM requires timely evaluation of data and responsiveness to observed trends. At each 5 year interval and at the end of the planned 13-year monitoring period, PDM data will be assessed to determine whether the data collection protocols are functioning as anticipated and whether any changes in species protection are needed. Potential outcomes include, but may not be limited to:

A. *PDM indicates that the species remains secure without ESA protections.* PDM could be concluded at the completion of the 13 year monitoring period. Additional monitoring may continue at the discretion of the Service and its partners, depending on availability of funding and resources.

B. *PDM indicates that the species may be less secure than anticipated at the time of delisting, but information does not indicate that the species meets the definition of threatened or endangered.* The duration of the PDM period may be extended, based on Service review over the PDM period. Additional parameters or increased monitoring frequency could be considered to increase the probability of detecting any future declines.

C. *PDM yields substantial information indicating threats are causing a decline in the species' status since delisting, such that listing the species as threatened or endangered may be warranted.* In addition to activities discussed under B, above, the Services should initiate a formal status review to assess changes in threats to the species, its abundance, productivity, survival, and distribution and determine whether proposal for relisting *Trichostema austromontanum* subsp. *compactum* is appropriate.

D. *PDM documents a decline in the species' probability of persistence, such that the species once again meets the definition of a threatened or endangered species under the*

*Act.* In the event that PDM reveals that *Trichostema austromontanum* subsp. *compactum* is threatened (i.e., likely to become endangered in the foreseeable future throughout all or a significant portion of its range) or endangered, then the species should be promptly proposed for relisting under the ESA in accordance with procedures in section 4(b)(5). Likewise, if the best available information indicates an emergency that poses a significant risk to the well-being of a delisted species, then the responsible Service should exercise its emergency listing authority under section 4(b)(7) accordingly.

## **6.1 Annual Report**

Annual reports will be provided to the Service and reviewed to evaluate the status of *Trichostema austromontanum* subsp. *compactum*. Reports will contain assimilated data from each threats-based monitoring effort (See Appendix C: Monitoring Protocols for *Trichostema austromontanum* subsp. *compactum*.)

- A. Trampling
  - a. Number of visitors
  - b. Activities: hiking or horseback
  - c. Instances of trampling
- B. Small Populations
  - a. Number of standing plants
  - b. Spatial distribution of plants
  - c. Presence/Identity of Nonnatives
- C. Local Weather
  - a. Temperature
  - b. Precipitation
  - c. Soil Moisture
  - d. Solar Radiation
  - e. Water level

## **6.2 Five Year Supplemental Report to Post-Delisting Monitoring Plan**

A more detailed analysis of compiled data will be performed after 5 years of monitoring. This will also serve to alert the Service to deteriorating situations leading to *Trichostema austromontanum* subsp. *compactum* meeting the criteria for listing. The Service will recommend that subsequent reports be produced to help analyze for trends and provide an opportunity for PDM plan review and adaptive management.

## **6.3 Public Outreach**

A better understanding of the biological limits and stressors of this taxon will help to ensure that it persists at Hidden Lake. The CDPR has produced Hidden Divide Natural Preserve brochures for distribution to educate the public on *Trichostema austromontanum* subsp. *compactum*.

Interpretative talks and signs could also be placed at strategic locations within the preserve to help conserve *T. a. subsp. compactum* at Hidden Lake.

## 7.0 Relisting Triggers and Potential Adaptive Management Responses

As summarized in our 2016 proposed delisting rule, available data suggest that the occurrence of *Trichostema austromontanum* subsp. *compactum* at Hidden Lake is stable and is not likely to become endangered in the foreseeable future throughout all or a significant portion of its range. Cumulative available data will be evaluated annually throughout the period of monitoring under this PDM plan. If data produced as part of or in conjunction with this PDM plan suggest that *T. a. subsp. compactum* are in decline or habitat destruction at Hidden Lake reaches a magnitude such that the species is likely to become endangered within the foreseeable future throughout all or a significant portion of the species' range, it would trigger potential commencement of relisting procedures.

If monitoring data indicate a potential decline of habitat suitability where *Trichostema austromontanum* subsp. *compactum* occurs, actions should be taken to ensure that continued decline does not pose a threat to *T. a. subsp. compactum* such that it will be likely to become endangered in the foreseeable future throughout all or a significant portion of its range. Actions to address a decline of habitat availability may include restrictions of activities or closures of areas to visitors.

Although fluctuation of standing plants may occur, this alone is not cause for potential commencement of relisting procedures. It is important to evaluate the population status over the term of this post-delisting monitoring period to consider the cause of a sustained decline in plant abundance, and how it may relate to the overall status of the species.

## 8.0 Estimated Funding Requirements

Estimated funding to implement this level of PDM for *Trichostema austromontanum* subsp. *compactum* is estimated at \$50,000. Approximate costs for field efforts per survey event are \$3,333. Therefore, approximately \$10,000 is needed to implement the PDM plan each year. Costs estimates are based on the minimum activities to survey three times per year (August, September, October) for 5 years over a 13 year monitoring period. Frequency of monitoring will occur at years 1, 4, 7, 10, and 13. This does not include additional survey events that may take place more regularly than the PDM indicated within this plan.

## 9.0 Public Review and Comment

The Notice of Availability of this PDM plan, published in the **Federal Register** opened a public comment period on this draft PDM plan. The Service solicits comments and information related

to the PDM plan, and you may submit comments and materials by any one of the following methods:

- Federal eRulemaking Portal: <http://www.regulations.gov>. Follow the instructions for submitting comments.
- U.S. mail or hand-delivery: Public Comments Processing, Attn: RIN 1018-BB39; Division of Policy and Directives Management; U.S. Fish and Wildlife Service; 4401 N. Fairfax Drive, Suite 222, Arlington, VA 22203.

We will not accept comments by e-mail or fax. We will post all comments on <http://www.regulations.gov>. This generally means that we will post any personal information you provide us (see the “**Public Comments**” section below for more information).

After the close of the comment period, the Service will review each comment received and prepare responses to substantive comments. Responses will be included in an appendix to the final PDM plan.



## 10.0 References

- Bauder, E.T., and S. McMillan. 1998. Current distribution and historical extent of vernal pools in southern California and northern Baja California, Mexico. *In*: Proceedings for ecology, conservation, and management of vernal pool ecosystems, pages 56-70. California Native Plant Society, Sacramento, California.
- Bauder, E.T. 1999. Environmental Factors and the Micro-distribution of Hidden Lake blue curls (*Trichostema austromontanum* subsp. *compactum*), Mount San Jacinto State Park, Riverside County, California. California Department of Parks and Recreation, Borrego Springs, California.
- [CDPR]. California Department of Parks and Recreation. April 2002. Mount San Jacinto State Park General Plan.
- [CNDDDB]. California Natural Diversity Database. California Department of Fish and Game. 2010. Element Occurrence Reports for *Trichostema austromontanum* subsp. *Compactum*. Unpublished cumulative data current to May 1, 2010.
- Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 2001. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+ 1730. National Business Center, Denver, CO
- Fraga, N. 2012. Monitoring for *Trichostema austromontanum* subsp. *compactum*.
- Fraga, N., and M. Wall. 2007. Conservation and Seed Banking of *Trichostema austromontanum* subsp. *compactum*. Submitted to U.S. Fish and Wildlife, Carlsbad, California and California State Parks, Inland Empire District, Perris, California. Dated March 16, 2007.
- Fraga, N., and K. Kietzer. 2009. A conservation strategy for *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls; Lamiaceae). Submitted to U.S. Fish and Wildlife, Carlsbad, California and California State Parks, Inland Empire District, Perris, California.
- Fraga N. and M. Wall. 2008. Activities report for conservation and seed banking of *Trichostema austromontanum* subsp. *compactum*. Prepared for Jonathan Snapp-Cook, U.S. Fish and Wildlife Service, Carlsbad, CA.
- Fraga, N., and M. Wall. 2010. Final report for conservation and seed banking of *Trichostema austromontanum* subsp. *compactum*. Submitted to U.S. Fish and Wildlife, Carlsbad, California and California State Parks, Inland Empire District, Perris, California. Dated February 19, 2010.
- Gregg B. 2007. Mount San Jacinto Ranger Station (Long Valley). Unpublished weather data.

- Hickman, J. C., ed. 1993. The Jepson Manual, Higher Plants of California. University of California Press, Berkeley.
- Noss, R.F., M.A. O'Connell, and D.D. Murphy. 1997. The science of conservation planning. Island Press, Covelo, California.
- Snapp-Cook, J. 2006. Field notes from Hidden Lake, July 11, 2006 by Jonathan Snapp-Cook, Botanist, U.S. Fish and Wildlife Service.
- Spira, T.P. 1980. Floral parameters, breeding system, and pollinator type in *Trichostema* (Labiatae). *American Journal of Botany* 67:278-284.
- [Service] U.S. Fish and Wildlife Service. 2006. *Trichostema austromontanum* subsp. *compactum*, 5-year review: summary and evaluation. U.S Fish and Wildlife Service, Carlsbad, California. 15 pp.
- [Service and NMFS] U.S. Fish and Wildlife Service and National Marine Fisheries Service. 2008. Post-delisting monitoring plan guidance under the Endangered Species Act. August 2008. 24 pp.
- Wallace, G. 2003. Field notes from Hidden Lake, July 8, 2003 by Gary Wallace, Botanist, U.S. Fish and Wildlife Service.
- Wallace, G. 2005. Field notes from Hidden Lake, July 30, 2005 by Gary Wallace, Botanist, U.S. Fish and Wildlife Service.

### **Federal Register Documents**

- [48 FR 43098] U.S. Fish and Wildlife Service. 1983. Endangered and threatened species; listing and recovery priority guidelines. *Federal Register* 48:43098–43105.
- [63 FR 49006] U.S. Fish and Wildlife Service. 1998. Endangered and threatened wildlife and plants; Final rule to determine endangered or threatened status for six plants from the mountains of southern California. *Federal Register* 63:49006–49022.
- [71 FR 56094] U.S. Fish and Wildlife Service. 2006. Endangered and threatened wildlife and plants; Prudency determination for the designation of critical habitat for *Trichostema austromontanum* subsp. *compactum*. *Federal Register* 71:56094–56098.
- [72 FR 54377] U.S. Fish and Wildlife Service. 2007. Endangered and Threatened Wildlife and Plants; Prudency Determination for the Designation of Critical Habitat for *Trichostema austromontanum* subsp. *compactum*. *Federal Register* 72:54377–54384.

### **Personal Communications**

Fraga, N. 2016. Email from Naomi Fraga to Bradd Bridges. Subject: Summary of population estimates for *Trichostema austromontanum* subsp. *compactum* at Hidden Lake and provided a monitoring protocol. August 16, 2016.

Kietzer, K. 2010. Telephone conversation with T. Archer, USFWS, subject: TRAUCO draft PDMP. Dated February 4, 2010.

Table 1. Summary of surveys for *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls) conducted from 2006-2009\* at the Hidden Divide Natural Preserve.

	Month	July	August	October
Year				
2006		<50 plants	1,148 plants	2,145 plants
2007		187 plants	58 plants	Survey not conducted
2008		27,000	8,000	>1,000
2009		Survey not conducted	>7,000	Survey not conducted

\*Table from Fraga and Kietzer 2009

Table 2. Population Estimates of *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls) conducted from 2012–2015\*. New survey methodology was adopted in 2011.

Year	Population estimate	Average Height	Average #of branches
2012	243750 (+/- 706)	1.86	0.97
2013	5100 (+/- 14)	1.39	1.92
2014	4612.5 (+/- 16)	1.46	0.7
2015	59250 (+/- 244)	1.35	1.14

\*Table from Fraga 2016, pers. comm.

(Numbers in parenthesis are the 95% confidence interval)

Table 3. Climate Data from Long Valley Weather Station and population size of *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls) at the Hidden Divide Natural Preserve (Gregg 2007, unpublished weather data).

Year	Snow Fall Sept-May (Inches)	Rain Fall Jan-Dec (Inches)	Mean Max August Temp (Celsius)	Population Size (High Estimate of Standing Plants)
1979	81.0	29.73	21.5	50
1980	140.0	52.06	22.78	10
1981	69.0	18.00	24.44	100
1982	109.0	47.58	22.11	10,000
1983	63.0	55.47	19.06	50
1984	13.0	16.16	20.61	1,000
1985	26.0	15.52	23.56	10,000
1986	123.0	19.46	22.94	10,000
1987	63.0	23.24	22.94	1,000
1988	101.0	13.84	22.22	1,000
1989	53.0	8.51	22.28	100
1990	60.25	12.71	23.39	100
1991	83.0		22.89	10,000
1992			22.67	10,000
1993			22.78	100
2006				2,145
2007				245
2008				27,000
2009				7,000

## **Appendix A: (FRAGA AND KIETZER 2009)**

### **ANNOTATED CATALOG OF THE VASCULAR FLORA**

**Compiled by Naomi Fraga**

The following is a list of all vascular plant taxa documented from the margins of Hidden Lake. This catalog is a result of field work and herbarium searches conducted as of August 2007. Family classification follows Flora of North America (2007), while classification of genera and species conforms to Hickman (1993). Specimens that are cited are housed at RSA unless designated by POM, UC, or UCR. Nonnative taxa are denoted by an asterisk (\*). Rare taxa are denoted by a dagger (†).

#### **CONIFERAE**

##### **PINACEAE**

*PINUS CONTORTA* Loudon subsp. (Grev. and Balf.) Critchf. *MURRAYANA* Tree. Surrounding Hidden Lake away from the margin of the Lake. *Fraga, et al. 1712*

#### **ANGIOSPERMAE – DICOTYLEDONES**

##### **ASTERACEAE**

*GNAPHALIUM PALUSTRE* Nutt. Annual. On the margin of Hidden Lake growing in coarse granite soil. *Fraga, Anderson, Hamilton, Wall, Wallace 1777*

##### **BORAGINACEAE**

*CRYPTANTHA MICRANTHA* (Torr.) I. M. Johnst. Annual. On the margin of Hidden Lake growing in coarse granite soil. *Wallace 4028*

##### **BRASSICACEAE**

*RORIPPA CURVISILIQUA* (Hook.) Bessey ex Britton. Annual or biennial herb. On the moist margins of Hidden Lake. *Hamilton s.n. 28 Jun 1981*

##### **CRASSULACEAE**

*CRASSULA AQUATICA* (L.) Schönbl. Annual. On the margin of Hidden Lake growing in coarse granite soil. *Fraga, et al. 1726*



#### ELATINACEAE

ELATINE BRACHYSPERMA A. Gray Aquatic annual. Growing in Hidden Lake, along lake edges. *Munz 6379 (POM)*

#### ERICACEAE

SARCODES SANGUINEA Torrey Perennial herb. In lodgepole pine understory. *Munz 6024*

#### FABACEAE

LOTUS NEVADENSIS (S. Watson) Greene var. *nevadensis* Perennial herb. On the upper margins of Hidden Lake. *Fraga et al. 1713*

LUPINUS HYACINTHINUS Greene Perennial herb. In understory of lodgepole pine forest away from the margin of the Lake. *Fraga, Anderson, Hamilton, Wall, Wallace 1738*

#### LAMIACEAE

†TRICHOSTEMA AUSTROMONTANUM H. Lewis subsp. H. Lewis COMPACTUM Annual. Along the margins of Hidden Lake in open areas in coarse granite soil. *Fraga, Anderson, Hamilton, Wall, and Wallace 1734*

#### ONAGRACEAE

GAYOPHYTUM DECIPIENS Harlan Lewis and J. Szweykowski Annual. On the upper margins of Hidden Lake and in lodgepole pine understory. *Fraga, Anderson, Hamilton, Wall, Wallace 1739*

#### POLEMONIACEAE

†LEPTODACTYLON JAEGERI (Munz) Wherry Perennial herb. On rock outcrops on slopes above Hidden Lake. *Fraga, Anderson, Hamilton, Wall, Wallace 1740*

#### PHRYMACEAE

MIMULUS BREWERI (E. Greene) Cov. Annual. Growing along the margins of Hidden Lake in coarse granite soil. *Fraga, et al. 1718*

MIMULUS FLORIBUNDUS Douglas ex Lindl. Annual. On the margin of Hidden Lake growing in coarse granite soil. *Fraga, Anderson, Hamilton, Wall, and Wallace 1778*

MIMULUS MOSCHATUS Lindley Perennial herb. Growing along the margins of Hidden Lake in coarse granite soil. *Hamilton s.n. 27 Jun 1981*

MIMULUS PILOSUS (Benth.) S. Watson Annual On the margin of Hidden Lake growing in coarse granite soil. *Fraga, et al. 1720*

MIMULUS PRIMULOIDES Benth. Perennial herb On the margins of Hidden Lake. *Wallace s.n.*

MIMULUS SUKSDORFII A. Gray Annual Growing along the margins of Hidden Lake in coarse granite soil. *Fraga, Anderson, Hamilton, Wall and Wallace, 1736*

#### PLANTAGINACEAE

KECKIELLA ROTHROCKII (A. Gray) Straw var. (Abrams) N. Holmgren JACINTENSIS Small shrub. On slopes near Hidden Lake. *Roos 2534*

VERONICA PEREGRINA L. subsp. (Kunth) Pennell XALAPENSIS Annual. On the margin of Hidden Lake growing in coarse granite soil. *Fraga, et al. 1719*

#### PORTULACACEAE

CALYPTRIDUM MONANDRUM Nutt. in Torr. and A. Gray Annual. On the margin of Hidden Lake growing in coarse granite soil. *Fraga, McDonald, and Wall 1875*

#### RUBIACEAE

GALIUM PARISHII Hilend and J. T. Howell Suffrutescent perennial. On slopes near Hidden Lake. *Munz 6022*

#### SCROPHULARIACEAE

LIMOSELLA ACAULIS Sessé and Mociño Aquatic annual. On the margins of Hidden Lake in coarse granite soil. *Fraga, Anderson, Hamilton, Wall, Wallace 1774*

#### ANGIOSPERMAE - MONOCOTYLEDONES

#### CYPERACEAE

CAREX MULTICAULIS L. H. Bailey Perennial herb. On the margins of Hidden Lake. *Fraga, et al. 1715*

CYPERUS SQUARROSUS L. Annual. On the margin of Hidden Lake growing in coarse granite soil. *Fraga, et al. 1724*

ELEOCHARIS ACICULARIS (L.) Roem. var. ACICULARIS Perennial herb On the margin of Hidden Lake growing in coarse granite soil. *Meyer 566 (UC)*

ELEOCHARIS BELLA Annual. On the margin of Hidden Lake growing in coarse granite soil. *Fraga, et al. 1727*

ELEOCHARIS MACROSTACHYA Britton Perennial herb. On the margins of Hidden Lake. James Reserve

LIPOCARPHA OCCIDENTALIS (A. Gray) G. C. Tucker Annual On the margins of Hidden Lake. *F.M. Reed 2433*

#### JUNCACEAE

JUNCUS BUFONIUS L. Annual. On the margins of Hidden Lake. *Fraga, et al. 1725*

JUNCUS DURANII Ewan Perennial herb. On the margins of Hidden Lake. *Fraga, et al. 1723*

JUNCUS TRIFORMIS Engelm. Annual. On the margins of Hidden Lake. *Munz 6374*

#### POACEAE

AGROSTIS IDAHOENSIS Nash Perennial herb. Growing along the upper margins of Hidden Lake. *Fraga, et al. 1714*

MUHLENBERGIA FILIFORMIS (Thurber) Rydb. Annual. On the margins of Hidden Lake. *Fraga et al. 1716*

MUHLENBERGIA MINUTISSIMA (Steudel) Swallen Annual. On the margins of Hidden Lake. *Roos 2*

#### POTAMOGETONACEAE

POTAMOGETON DIVERSIFOLIUS Raf. Aquatic perennial herb. Growing in Hidden Lake. *Fraga et al. 1722*

Appendix B:  
(Fraga and Kietzer 2009)

Hidden Lake Visitor Impacts Monitoring Data Sheet

(Page 1 of 2)

**Hidden Lake Visitor Impacts Monitoring Data Sheet**

**Date:**

**Time:** Start:                      End:

**Observer(s):**

**Physical Environment**

**Weather Conditions:** (circle one):

Sunny    Partly Cloudy    Mostly Cloudy    Overcast    Rain    Snow

Air Temperature:

Water Temperature:

**Basic Pool Characteristics:** (circle one) (see example photos)

Pool flowing over spillway     $\frac{3}{4}$  Full     $\frac{1}{2}$  Full     $\frac{1}{4}$  Full    dry    ice present

Other pool observations:

**Flora and Fauna**

*Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls):

Estimate of number of individuals:

\_\_\_\_% vegetative; \_\_\_\_% flowering; \_\_\_\_% fruiting

Toad Population: (circle one or more)

Eggs present    tadpoles    young toads    adult toads    No toads

Other site observations:

Plants:

Wildlife:

Other notes:

**Visitor Information**

Observed Visitor Activity:

Were there any visitors present?: (circle one) Yes    No    If Yes, how many:

What did they do while at the lake?

Did have any contact with any of the visitors? (circle one) Yes    No

If Yes, what was the subject of the contact.

**(Page 2 of 2)**

Date:

Observer(s):

**Visitor Information (continued from page 1)**

Evidence of Recent Visitor Activity:

Signs of vegetation trampling (circle one) Yes No

Signs of trampling of *Trichostema austromontanum* subsp. *compactum* (Hidden Lake bluecurls)  
(circle one) Yes No

Human footprints on volunteer trail? (circle one) Yes No

Footprints around the basin? (circle one) Yes No

Animal tracks in or around Hidden Lake? (circle one) Yes No  
If so, what type and where? (especially note horse, cattle, sheep)

Other evidence of animals? (circle one) Yes No  
If so, describe.

Trash present? (circle one) Yes No If yes, what kind?

Evidence of illegal camping (fire rings, fire scars on rocks, etc.)? (circle one) Yes No  
If Yes, what kind of evidence?

Did you take any pictures? (circle one) Yes No  
If yes, what medium and where will they be logged? (film, digital)

**Other Notes:**

## **Appendix C:**

### **Monitoring Protocols for *Trichostema austromontanum* subsp. *compactum***

## **Monitoring Protocol for *Trichostema austromontanum* subsp. *compactum***

### **Method 1 (Fraga and Kietzer 2009):**

Monitoring for *Trichostema austromontanum* subsp. *compactum* should be conducted multiple times in one year during the flowering season to document the location of germinating plants and to track changes in phenology throughout the season. Monitoring should try to include characterization of microsite occupancy, characterization of life-cycle timing relative to physical and climatic factors, characterization of biotic interactions (e.g., pollination and seed dispersal), and characterization of changes in reproductive cycle (increases and decreases). Ideally the population would be monitored at least three times from July to September. Monitoring protocols are outlined below:

- (1) Shapefiles (polygons) for each sub–population should be created with an accurate (sub-meter accuracy) GPS unit. To create polygons, each sub–population should be mapped by flagging the perimeter and walking to each flag with the GPS unit.
- (2) The number of individuals within each sub–population should be counted with a hand tally counter. This nested approach will give more accurate and detailed information for viewing population changes over time.
- (3) The percentage of individuals in vegetative, flowering, and fruiting stages should be recorded within each flagged sub–population.
- (4) Any threats observed should be recorded (i.e. trampled plants, herbivory, etc.).
- (5) The level of the lake should also be mapped and a photo of the lake taken from the established photo plot.








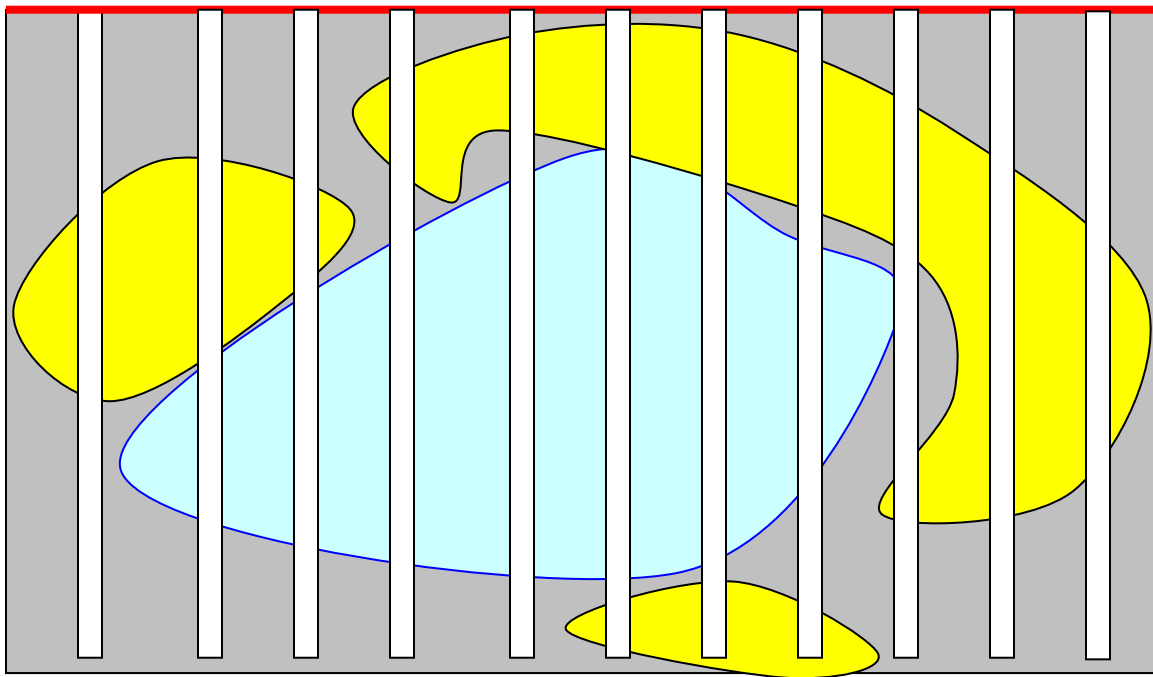
**Monitoring Protocol for *Trichostema austromontanum* subsp. *compactum***

**Method 2 (Fraga 2012; modified to remove specific location of Hidden Lake):**

Monitoring for *Trichostema austromontanum* subsp. *compactum*

**Legend**

-  Hidden Lake
-  Hypothetical Area of Occupancy
-  0.5m x 75 m Quadrat
-  Macro Plot (100 m x 75 m)
-  Transect



**Management Goals:**

**Maintain zero weed species at Hidden Lake**

**Provide a baseline against which future change is measured.**

**Monitoring Protocol for *Trichostema austromontanum* subsp. *compactum* using restricted random sampling**

- A. If <1000 plants are present, hand count the entire population for a total census.
- B. If plants are too numerous to count (ca. >1000 plants) use restricted random sampling method as outlined below.
  - 1. Macro Plot was established in 2010, the rebar in the ground marks the four corners.
  - 2. Relocate macroplot boundaries with a GPS and/ or metal detector.
  - 3. Run a meter tape along the north and south end of the macroplot; running W-E (100m)
  - 4. Mark the north and south sides of the transect with pin flags every 10m in a randomized fashion (pick number 1-10 out of a hat) along the tape to establish N end of quadrats.
  - 5. Record the pin flag intervals on the data sheet. (i.e. transect one, meter 1; transect 2, meter 5)
  - 6. Run a second meter tape N to S (75 m) at each pin flat to mark the west side of the quadrat
  - 7. Use 0.5m long pvc pipe or meter tape to establish the east edge of the quadrat.
  - 8. Measure each plant within the quadrat. It may help to mark plants with pinflags to keep track of which plants have been measured.
  - 9. Two measurements will be taken for each plant: plant height (cm) and total number of branches.
  - 10. Measurements will be taken for each plant so the total number of measurements for each quadrat will equal the number of plants in each quadrat.
  - 11. Use quadrats to monitor for weeds.
  - 12. Record percent cover of weeds (if any) along the quadrat and voucher weeds for proper identification.

Transect  
Number: \_\_\_\_\_  
Transect  
Position: \_\_\_\_\_ m  
Survey Team: \_\_\_\_\_  
Recording: \_\_\_\_\_  
Date: \_\_\_\_\_

Species: *Trichostema austromontanum compactum*  
 Quadrat dimensions 0.5m x 75m

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**Statistical analysis of random stratified sampling method for *Trichostema austromontanum* subsp. *compactum***

1. Estimate population means following Stratified Random Sampling worksheet in Elzinga, Salzer & Willoughby 2001 (page 379).
2. Use analysis of variance (ANOVA) to test for a significant difference between the estimated population means for each year of monitoring. And regression analysis to analyze relationship between population mean and precipitation or other climate variables.

Year	Sample size (n)	Mean	SD	SE	Annual Precipitation	Annual High temp	Annual low temp
2011							
2012							
2013							
2014							
2015							

**List of Materials:**

- **GPS**
- **Compass**
- **Metal detector**
- **Two 100 meter tapes**
- **Pin flags**
- **Ruler**
- **Data Sheets**
- **0.5 m long pvc pipe or measuring tape**
- **Clip board**
- **Pencils**
- **Small pin flags or brightly colored swizzle sticks.**

## **Appendix D:**

### **Use of *Ex Situ* Collection for the Conservation of *Trichostema* *austromontanum* subsp. *compactum* (Fraga and Kietzer 2009)**

## **Use of *Ex Situ* collection for the Conservation of *Trichostema austromontanum* subsp. *compactum***

The existing off site seed collections at the RSABG Seed Storage facilities are intended to serve as a source of material for reintroduction and recovery and for research that supports the *in situ* conservation of *Trichostema austromontanum* subsp. *compactum*. Three important issues relating to the long term usefulness of these collections are:

1. Maintaining viability and genetic quality in the off site germplasm collections.
2. Defining what events or conditions would trigger the use of the collections in a reintroduction program.
3. Determining how to make the best use of the material in a reintroduction program.

### ***Viability of the existing collections***

If the quantity or viability of the stored collections falls below a minimum threshold level decisions will need to be made whether to regenerate the seed collections or to recollect from the wild populations. The minimum threshold level should be determined based on information obtained from the initial and subsequent germination trials, the health and vigor of the collections over time (exhibited storage tolerance), the quantity of viable seeds in storage and the genetic quality of the collection (number of genotypes represented in the collection).

Information needed to develop a minimum threshold level for the off-site collection(s):

1. Minimum quantity of viable seed needed.
2. Minimum number of genotypes needed.
3. Maximum germination rate.
4. Viability over time.
5. Seedling vigor and development over time.
6. Seed production per individual over time from Garden origin plants.

### ***When to initiate a reintroduction program***

It appears that plants of this species do not germinate or reach a reproductive stage readily in extremely wet or extremely dry years. In 1993, a very wet year with high water levels, less than 100 seedlings were documented at the lake (Bauder 1993). In 2007, an especially dry year in which the lake was not known to hold water, the number of plants observed was 245 (Fraga and Wall, 2007). In years of adequate rainfall the size of the population appears to fluctuate widely from more than 10,000 individuals in a year (Bauder 1999) to more than 27,000 individuals in 2008 (Fraga and Wall, 2008). It is not known how many successive low population years the population can withstand and what the effects this would have on the long-term viability of the population. It is also not known how long the seeds remain viable in the soil seed bank. If changes in environmental conditions have caused the population to decline it is possible that the site may no longer be capable of maintaining a viable population.



Information needed to determine when a reintroduction program should be initiated:

1. Annual population census and seed production data.
2. Assessment of conditions to determine the reason(s) for the population decline.
3. Development of a model for predicting population fluctuation based on 1 and 2.
4. Quantity and viability of seeds recovered from the existing soil seed bank.
5. Noted changes in genetic diversity.

***How to use the *ex situ* materials in a reintroduction program***

The first work would be to set up a recovery team, determine project scope and costs, seek funding sources and develop an experimental reintroduction plan for the species under the current site conditions.

Information needed to design and set up a reintroduction program:

1. Current suitability of the recovery site.
2. Literature review of published reintroduction work on rare annual species.
3. Determine the best introduction methods: direct seedling, transplants, or both.
4. Quantity of material needed over the course of the project.
5. Assess current status of the *ex situ* collections; initiate a seed regeneration program if and as necessary.
6. Minimum founder population size.
7. Timing, optimum soil moisture levels, and placement of introduced plants/seeds.
8. Maintenance and protection needs for introduction of plants/seeds.